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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/003,358	11/14/2001	Fang-Cheng Chang	NTI-022	4650

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EXAMINER
LIN, SUN J

ART UNIT	PAPER NUMBER
2825	

DATE MAILED: 02/23/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

	Application No.	Applicant(s)
Office Action Summary	10/003,358	CHANG, FANG-CHENG
	Examiner	Art Unit	
	Sun J. Lin	2825	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *Amendment & Remarks filed on 11/12/2004.*

2a)☒ This action is **FINAL**.   2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27* is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-27* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *11/14/2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All   b)☐ Some * c)☐ None of:

      1.☐ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☐ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.

4)☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: _____.

DETAILED ACTION

1.   This Office Action is in response to applicant's Amendment and Remarks filed on
11/12/2004 regarding application 10/003,358 filed on 11/14/2001. Claims 1 – 27 remain
pending in the application.

Claim Rejections - 35 USC § 103(a)

2.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all
obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set
> forth in section 102 of this title, if the differences between the subject matter sought to be patented and
> the prior art are such that the subject matter as a whole would have been obvious at the time the
> invention was made to a person having ordinary skill in the art to which said subject matter pertains.
> Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459
(1966), that are applied for establishing a background for determining obviousness
under 35 U.S.C. 103(a) are summarized as follows:

(1).   Determining the scope and contents of the prior art.
(2).   Ascertaining the differences between the prior art and the claims at issue.
(3).   Resolving the level of ordinary skill in the pertinent art.
(4).   Considering objective evidence present in the application indicating obviousness
        or nonobviousness.

3.   Claims 1 – 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over
U.S. Patent No. 6,272,236 B1 to *Pierrat et al.* in view of U.S. Patent No. 6,057,063 to
Liebmann et al.

4.   As to Claim 1, *Pierrat et al.* show and teach the following subject matter:

*   *Image simulation* procedures capable of detecting *anticipate defects* on a
    mask – [col. 3, line 14 – 26]; *capturing* (i.e., *generating*) *inspection image* of *a
    portion* (e.g., *critical feature*) of the mask and creating a *simulation* of *resist* to
    be formed (on a wafer) according to the *inspection image* – [col. 3, line 49 –
    51]; Notice that *the portion of mask* containing a *critical feature*, which
    requires special attention, is an *area of interest (AOI)*; Therefore, an *AOI*
    (*area of mask containing a critical feature portion*) is identified first, and then

an *inspection image* of the *critical feature portion* in the *AOI* is *generated* for use in the simulation;

- *Mask pattern* is manufactured from *original (design) pattern data* – [col. 3, line 45 – 46];
- *Mask inspection machine* can be applied to any particular type of masks, which include **photomask** and **phase shifting mask** – [col. 6, line 19 – 27]; Notice that (1) a *photomask* is designed for a *desired design pattern*, including a *critical feature portion* in an AOI, it is manufactured utilizing *original (design) pattern data* – [Fig. 3] **(2) a phase shift mask associated with the AOI is constructed based on design geometry information regarding an area outside the AOI without use of inspection images of that area.**

Pierrat et al. do not disclose information about construction of *phase shifting mask* and its relationship with a (critical) feature. But *Liebmann et al.* show and teach the following subject matter:

- A process for creating and verifying a design of *phase-shifted mask* – [title; abstract];
- *Phase-shifted masks* are deployed to (critical) features in a chip design that require phase shifting – [abstract; col. 3, line 59 – 62];
- *Phase-shifted mask* contains *colored phase regions*, which are created on *opposite sides* of features – [abstract; Fig. 1 – Fig. 4]; *Proper phase termination* (e.g., 180° out of phase) of the *phase regions* is ensured based upon *space constraints* of a *phase-shifted mask* technique utilized – [abstract].

In addition, *Liebmann et al.* also teach that phase shifted mask (PSM) lithography is applied to improve the *lithographic process latitude* in order to replicate *small image* (i.e., *critical feature*) in a chip design – [col. 2, line 34 – 56].

Therefore, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to have applied the teachings of *Liebmann et al.* in utilizing *phase shifted mask* to improve the *lithographic process latitude* in order to replicate *small image* (i.e., *critical feature*) in the AOI.

Notice that _Liebmann et al._ also show and teach the following subject matter:

- a _photomask design_ showing _(critical) feature edges_ – [Fig. 1];
- _phase regions_ of _phase shifted masks_, which are deployed around the _photomask_ of each _(critical) feature edges_ – [Fig. 2];

Therefore, in order to appropriately deploy the appropriate _phase regions_ of a _phase shifting mask_ around an AOI having a _critical feature_, the _design geometry information_ regarding an area outside the AOI should be provided and modified to accommodate the _phase regions_.

Combining the teachings of _Liebmann et al._ and _Pierrat et al._, the following subject matter is disclosed utilizing Fig. 1 of _Pierrat et al._:

- Simulation of a _critical feature_ in the AOI is performed in Step 180 based on the _inspection image_ of the AOI and the _phase regions_ of a _phase shifting mask_ deployed around the AOI according to _design geometry information_ regarding an area outside of the AOI– [Fig. 1]; Notice that (1) the image simulation of _desired design pattern_ of the critical feature (AOI) under study is performed in Step 185 (2) inspection images of the phase shifting mask are not used in the simulation.

For reference purposes, the explanations given above in response to Claim 1 are called **[Response A]** hereinafter.

5. As to Claim 18, reasons are included in **[Response A]** given above.

6. As to Claim 27, reasons are included in **[Response A]** given above. Notice that based on the explanations included in **[Response A]**, a computer program product can be generated to perform the subject matter as recited in Claim 27.

7. As to Claim 25, reasons are included in **[Response A]** given above. Notice that accuracy of the _critical feature_ is based on the following factors:

- a _mask inspection image_, which has a _defined area_ (i.e., _area defined the critical feature_); and

- _design geometry information_ regarding an area outside the defined area, where appropriate _phase regions_ of _phase shifting mask_ are deployed around the defined area.

For reference purposes, the explanations given above in response to Claim 25 are called **[Response B]** hereinafter.

8.   As to Claims 2 and 19, _modifying data_ include _colors_ and _layout data_ of _phase regions_ for use in the _phase shifting mask_ around the _critical feature_ in the AOI in order to achieve appropriate phase shifting.   Notice that the _colors_ of phase regions are set to control the degree of phase shifting (e.g., 180° out of phase) between the phase regions.

9.   As to Claims 3 and 20, _modifying data_ includes **_generating_** _phase regions_ of _phase shifting mask_ outside and around the AOI and **_combining_** the _inspecting image_ of _critical feature_ and the _phase regions_ of _phase shifting mask_.   Notice that an image generated by the _phase regions_ of _phase shifting mask_ is a _phase shifting image_, which is a _virtual image_.

For reference purposes, the explanations given above in response to Claims 3 and 20 are called **[Response C]** hereinafter.

10.   As to Claim 4, as explained in **[Response A]** given above, the _simulation 180_ is performed on the _combined images_ 160.2, which is a combination of the _inspecting image_ and the image of _phase regions_ of _phase shifting mask_ received from Step130 – [Fig. 1].

For reference purposes, the explanations given above in response to Claim 4 are called **[Response D]** hereinafter.

11.   As to Claims 5, 6 and 21, reasons are included in **[Response C]** and **[Response D]** given above.

12.   As to Claims 7 and 22, _Pierrat et al._ show and teach digitized image of entire mask, including feature in AOI and (design geometry information for use in construction

of associated phase shifting mask – [Fig. 1; Fig. 3; col. 5, line 45 – 50]. Notice that a
digitized image is a _bit map image_, which is made of _bits_ "1" and bit "0".

For reference purposes, the explanations given above in response to Claims 7
and 22 are called **[Response E]** hereinafter.

13.   As to Claims 8 and 23, the _design geometry information_ is utilized in formation of
phase shifting mask for a (_critical) feature_ in an AOI. Therefore, the _design geometry
information_ includes extending geometries of the _(critical) feature_ in the _AOI_ –
[_Liebmann et al._; Fig. 1 – Fig. 5].

14.   As to Claims 9 and 10, as explained in **[Response A]** given above, providing
design geometry information includes accessing information regarding another mask,
which is a _phase shifting mask_ – [_Liebmann et al._; Fig. 1 – Fig. 5].

For reference purposes, the explanations given above in response to Claims 9
and 10 are called **[Response F]** hereinafter.

15.   As to Claim 24, reasons are included in **[Response F]** given above. Notice that, in
design of an appropriate _phase shifting mask_, _database information_ regarding _phase
shifting (i.e., colors)_ and _sizes_ for use in design of _phase regions_ of the _phase shifting
mask_ needs to be accessed.

For reference purposes, the explanations given above in response to Claims 9
and 24 are called **[Response G]** hereinafter.

16.   As to Claim 26, in addition to reasons included in **[Response A]**, **[Response B]**,
[Response C], and **[Response D]** given above, _Liebmann et al._ and _Pierrat et al._ show and
teach the following subject matter:

- _(Photomask) image simulation_ obtained in Step185 is based on _desired
  pattern database_, it provides a _first accuracy_ – [_Pierrat et al._ – Fig. 1];
- _Mask inspection image_ with _phase shifting mask_ generated in Step180
  provides an _improved accuracy_ – [_Pierrat et al._ – Fig. 1; _Liebmann et al._, col.
  2, line 34 – 40];

- *Improved accuracy* of *image simulation 180* is compared with *first accuracy* in *image simulation 185* to detect defect in 140 – [*Pierrat et al.* – Fig. 1].

17.   As to Claim 11, in addition to reasons included in **[Response A] and [Response G]** given above, *Pierrat et al.* teach that the *inspection image* is a *digitized image* generated from an *inspection tool* (e.g., *scanning electron microscope* SEM) – [col. 5, line 8 – 18; col. 5, line 45 - 50]. Notice that the *Inspection image* is *first information* relating to a *first area* (i.e., *AOI*) – **[Response A]**. *Second information* is obtained from *design geometry information* (i.e., *design file* for *phase shifting mask*). The *Second information* is related to area of *phase region* (i.e., *second area*) of *phase shifting mask* outside the *first area* (*AOI*) – **[Response G]**. Notice that the first information (inspection image of AOI) and the second information (phase shifting mask) provide enhanced simulation accuracy of the first area (AOI).

18.   As to Claim 12, reasons are included in **[Response E]** given above.

19.   As to Claims 13 and 14, *Liebmann et al.* show in Fig. 1 and Fig. 2 and teach that the *second area* (*phase region*) for use in designing a *phase shifting mask* is defined by a predetermined *spacing* (i.e., *distance*) or a plurality of *spacings* (i.e., *distances*) from a perimeter of the *first area* (i.e., *feature edge* under study) dependent upon *structure* and *size* of the critical feature edge in the *first area.*

20.   As to Claim 15, the *first area* is a *feature* in any *AOI*. The *first area* (*feature*) can be *defined* by an *engineer* (i.e., *user*) by choosing an AOI when operating the *simulation engine*.

21.   As to Claim 16, *Liebmann et al.* teach the following subject matter:
- *Phase shifted mask design system* for manufacturing VLSI circuit device – [abstract];
- Mask process for creating and verifying a design of *phase shifted mask* utilizing at least one *phase shift region* employing a *computer-aided design system* – [abstract]; Notice that the *phase shifted mask design system* is a *computer-aided*

design system; The _second area_ (_phase region_) can be defined by the _phase shifted mask design system_

- _Critical features_ in a design of the _phase shifted mask_ (for a VLSI circuit device) that required _phase shifting_ are located – [abstract]; Notice that the **_first area_** (i.e., _critical feature_) is _located_ (i.e., _defined_) by the _phase shifted mask design system_.

22.   As to Claim 17, as explained in **[Response A]** given above, the _first area_ relates to _photomask_ (i.e., _first mask_) of a _desired pattern_ of a _critical feature_ and the _second area_ (_phase regions_) relates to _phase shifting mask_ (i.e., _second mask_) associated with the _photomask_ (_first mask_).

Response to Amendment and Remarks

23.   Applicant's amendment and remarks filed on 11/12/2004 have been reviewed. Applicant's arguments have been fully considered but they are not persuasive. Detailed responses to applicant's argument are included in the office action given above.

Conclusion

24.   **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sun J. Lin whose telephone number is (571) 272-1899. The examiner can normally be reached on Monday-Friday (9:00AM-6:00PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on (571) 272-1907. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7382 for regular communications and (703) 305-3413 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1782.

Sun James Lin
Patent Examiner
Art Unit 2825
February 9, 2005

VUTHE SIEK
PRIMARY EXAMINER